Biologist Traces Light Effect on Life Rhythm

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CLOUDCROFT, N.M., June 21—A French geologist by the name of de Marain puzzled over what caused the leaves of plants to sleep and awaken with an apparent regularity. Nagged by his curiosity, de Marain took a mimosa plant deep into a cave where there would be no light and where the temperature would be constant.

With a regularity of his own, the geologist inspected the plant by candlelight. To de Marain's amazement, the daily sleep oscillations or periodic rhythms persisted in spite of the total absence of sunlight and the constant temperature.

That was in 1725. Today, the sleep movements of leaves still are baffling. No one knows for certain what is the true function of this daily rhythm, which has since been demonstrated in man, mouse, microorganism and molecule.

Here this week, a Princeton University biologist suggested some answers. If he is right, science will have hithertbo unimaginable insights into evolution, into how all living things are shaped and regulated and into the interaction of light and daily rhythms on all life processes.

Innate in All Organisms

Colin Pittendrigh of Princeton is one of the world's leading authorities on biological clocks. These are delicate time-measuring mechanisms innate in all living organisms. Such clocks, set by the sun, are what make birds and bees uncanny navigators. They also regulate growth and development.

At an Air Force Office of Scientific Research seminar here, Pittendrigh set forth some new theories about these and other biological rhythms. Basing his ideas on his own experimental work, that of other scientists, and speculation, Pittendrigh proposed the following:

Visible light has evolved through natural selection as the universal switch that controls biorhythms. Biorhythms, in turn, control critical life processes ranging from growth in plants to the action of genes in humans.

What happens, apparently, is that light falls upon light-sensitive cells, perhaps even molecules. These cells act as alarm clocks, whose timing depends upon when and how much light is detected.

Too much light can be deleterious. In constant light, plants become stunted. An interruption of light can interrupt and change normal behavior A beclouded sun confuses birds and bees. A transcontinental airplane trip can upset human metabolism.

Reactions Take Place

Once light is detected, however, a series of biochemical reactions takes place. In plants and animals, the amount of light "tells" flowers that the time has come to flower, and caterpillars that it is time to build a cocoon. In humans, it appears that light brings genes into action and appears to regulate vital biochemical events such as starting or stopping the production of enzymes.

There are options, apparently. For some unexplained reason, the lack of oxygen can inhibit some life processes, such as protein synthesis, for up to five hours. But more significantly, cells can prefer to wait until dark to perform certain chores, just as it now appears that the cells employ the dark to prevent potentially dangerous overwork.

Capping these speculative suggestions, Pittendrigh cited new work by another scientist that indicates that before any development gene can perform its function, such as endowing eye color, it must first get in and out of light and at the same time wait its turn according to the biological rhythm set for the organism.

This would be as if genes were horses in a starting gate. Light opens the gate, but instead of all the horses flying out together, only the first horse can leave his stall. However, if the first horse is not ready, the gate closes. It opens again only after a preset biological rhythm has completed its cycle and so on down the starting gate.

Pittendrigh is not dogmatic about his ideas. Rather, he suggests that oscillations or biological rhythms are serving a fundamental function that is not yet fully identified. About the only things he is certain of is that all organisms undergo oscillations that have a periodicity that matches that of the external world, roughly 24 hours, and that light, even negligible amounts, can alter these ubiquitous oscillations.

Expects Vital Clues

Nonetheless, in Pittendrigh's view, once the true face of biological clocks are seen, science will have vital clues to how life developed during its evolution on earth and how biological rhythms determine what it is all living things do.

The British-born biologist also stressed that it makes an enormous difference when drugs are administered or biochemical tests made.

"It is a fundamental error," Pittendrigh said, "to think that the synthesis of bodily biochemicals or the administration of drugs has the same effect throughout 24 hours. We oscillate in complex ways during different times of the day.

"A rose is not necessarily a rose. A rose at 10 o'clock in the morning is different from a rose at midnight."